

Shrimp Trawl Bycatch in the Galveston Bay System

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Commercial harvesting of shrimp from the Galveston Bay system is an important economic asset to the State of Texas. Annual harvest from Galveston Bay averages 3.5 million pounds and approximately \$6.5 million. However, shrimp harvesting also may impact finfish and other invertebrates that may be of commercial, recreational, or ecological value by generating "bycatch", the unwanted or non-targeted portion of a shrimp trawler's efforts. Since the bay supports extensive commercial and bait shrimp industries, an analysis of the bycatch from the shrimp fishery is extremely important to the Galveston Bay characterization program. Bycatch species are usually discarded after shrimp (*Penaeus* spp.) and edible or bait fishes are removed. Of particular interest are recreational species populations such as red drum (*Sciaenops ocellatus*) and spotted seatrout (*Cynoscion nebulosus*) which the State of Texas (Texas Parks & Wildlife Department) augments through stocking programs. Very little information is available regarding bycatch of either the bait shrimp fishery (which operates throughout the year) or the bay commercial fishery (which has two main seasons).

Historical information on bycatch in Galveston Bay is limited to several studies during the mid 1980s (Lamkin, 1984; Bessette, 1986) in which samples were collected from live-bait vessels. In the Bessette study, bycatch CPUE (catch per unit effort) averaged 35.3 kg/hr (\pm 35.8 kg/hr). Atlantic croaker, Gulf menhaden, and spot croaker were the dominant species (by number and biomass) recorded and bycatch averaged about 65% (range = 2-98% for individual tows) of the total catch by weight. Results from new sampling efforts are comparable with respect to variability in distribution and abundance of bycatch species. Historical data show that recreational species (southern flounder, red drum, and spotted seatrout) were captured very infrequently. New sampling efforts indicate similar results during 1992. Similar to data collected in the historical studies, recreational species were caught frequently.

The National Marine Fisheries Service (NMFS) Galveston Laboratory conducted a comprehensive investigation of shrimp trawl bycatch in Galveston Bay during the 1992 shrimp harvest. This investigation addressed the magnitude, composition, and seasonality of bycatch associated with shrimp trawling operations in Galveston Bay. The delineation of status and trends of fishery organisms in the estuary would be enhanced if the magnitude of bycatch could be estimated. Specific objectives for this study included: 1) a review of historical information on trawling bycatch in Galveston Bay; 2) completion of new sampling efforts in three major fishing areas in Galveston Bay, collecting data to calculate the magnitude of bycatch; and 3) an attempt to link bycatch data from new sampling efforts with data from independent fishery surveys of

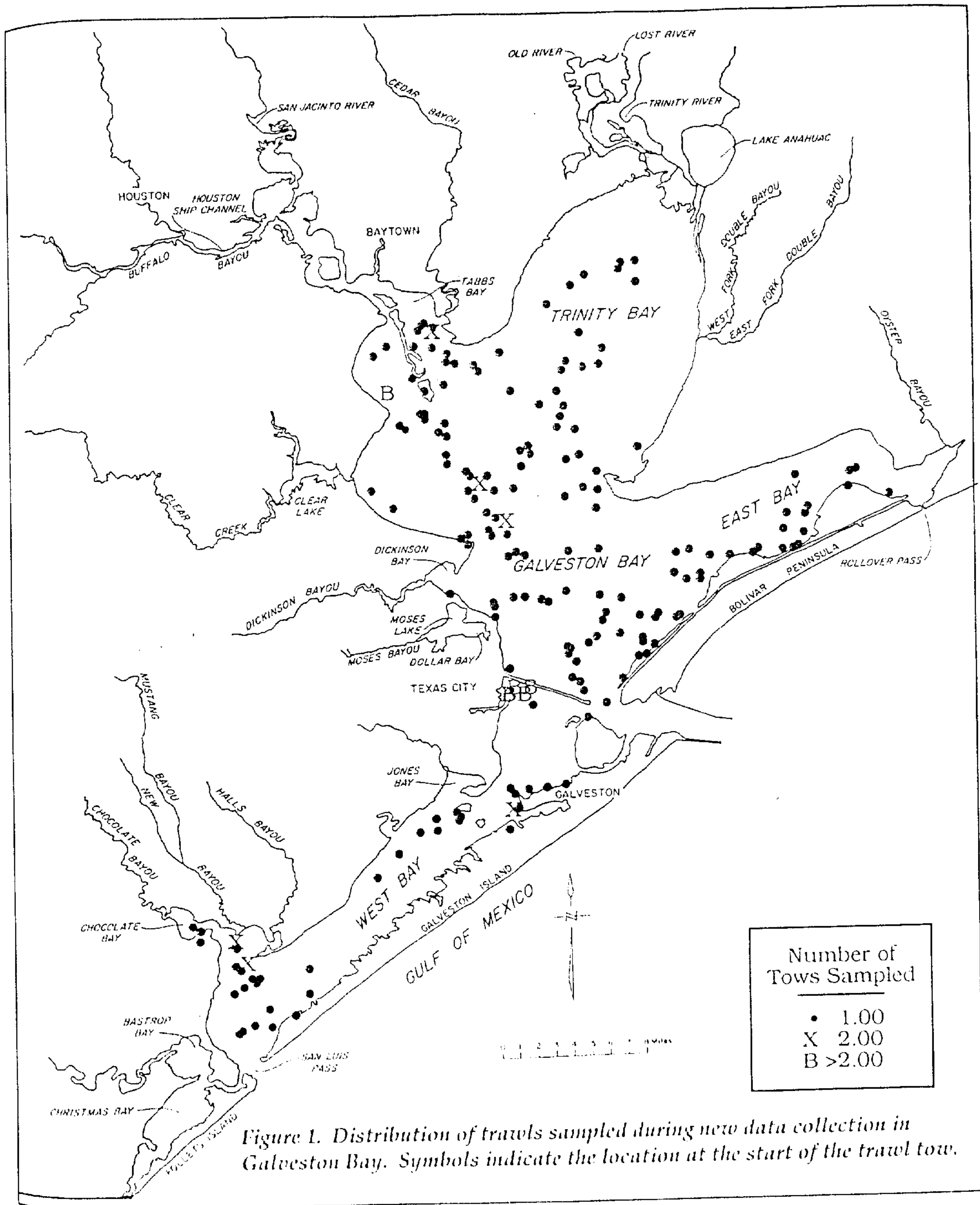
the Texas Parks & Wildlife Department for developing indices, which can be used to estimate bycatch intensity in future years.

Prior to initiating new sampling and data collection efforts, an industry advisory panel was assembled to act as a vehicle of communication between the fishing industry and principal investigators for the project. The industry review panel was composed of three members encompassing commercial and live-bait fishing, as well as shrimp processing and distribution (retail and wholesale) interests. The primary functions of panel members were to review sampling methodologies and data reports; recommendations of the advisory panel were considered without bias. Furthermore, panel members maintained a link with the fishing community and assisted in obtaining fishing vessels to participate in the study.

NMFS observers accompanied commercial and live bait shrimpers during trawling operations in Galveston Bay between March and November 1992. On sampling days, individual fishermen were randomly selected from a pool of over 25 vessels throughout three major fishing zones within Galveston Bay: Trinity Bay, upper & east Galveston Bay, and lower & west Galveston Bay. Shrimpers were instructed to fish normally, in areas of their preference. Fishermen were compensated for allowing observers to collect samples and other trawl information. Samples from each tow (standardized weight of 25 lbs. each) were collected, iced, and returned to the laboratory for processing and analysis. Over the March-November period, sampling trip intensity followed seasonal fishing effort patterns; thus, ensuring that data collected were representative of the shrimp fishery trends during 1992. In addition to collecting bycatch samples, observers recorded tow location, duration and speed, net length and mesh size, and environmental parameters (salinity, temperature, water conditions, etc.).

A total of 296 tow samples were collected from 20 different vessels. The majority of the samples were taken from the upper (171) and lower (91) bay fishing zones (Figure 1). Only 34 samples were collected in Trinity Bay, due to lack of fishing effort in that area. Low salinities (April-July) and poor shrimp catches (June-August) in Trinity Bay were the primary reasons for the decrease in fishing intensity. Approximately 1/3 to 1/2 of the samples were collected from vessels that fish primarily for live bait shrimp.

Overall, magnitude and composition of bycatch were extremely variable with respect to location and season. Approximately 125 bycatch species were captured during the year, with most of the diversity observed in the middle and upper bay areas during June-September. Atlantic croaker (*Micropogonias undulatus*), Gulf menhaden (*Brevoortia patronus*), sand seatrout (*Cynoscion arenarius*), cutlassfish (*Trichiurus lepturus*), bay anchovy (*Anchoa mitchilli*), hardhead catfish (*Arius felis*), spot croaker (*Leiostomus xanthurus*), brief squid (*Lolliguncula brevis*), and blue crabs (*Callinectes sapidus*) were generally the dominant bycatch species caught. Ranking of dominant species varies somewhat due to size differences among species captured (i.e., the dominant species caught in terms of numbers may not be the dominant species in terms of biomass). Similar to data collected in the historical studies, recreational species were caught infrequently.



The numerical ratio of shrimp to finfish ranged from 10.7 fish captured for every shrimp landed in March, to 4.4 shrimp for every fish caught during September. The overall value for the March-November sampling period resulted 1.9 shrimp landed for every fish captured. In terms of biomass, the 1992 data shows that overall weight of finfish captured surpassed shrimp landings by a factor of approximately 2.6 (i.e., 2.6 kg of fish for every 1 kg of shrimp landed). With the exception of March and April (when only small shrimp were caught in few numbers), finfish biomass ranged from 1.0 to 4.9 kg captured for every kilogram of shrimp landed. During March and April, finfish catches were 32.78 and 17.33 kg, respectively, for every kilogram of shrimp landed. Generally speaking, shrimping effort during these two months is low and primarily exerted by live-bait shrimpers; the commercial bay season does not open until the middle of May.

Monthly ratios of shrimp to finfish (and shrimp to invertebrates) were used to estimate biomass of total bycatch for the Galveston Bay system. Ratios were compared with monthly landings data (collected by NMFS) to extrapolate estimates for finfish and invertebrate catch weights. The extrapolated values ranged from 105,481 kg (November) to 875,034 kg (July) of finfish captured in shrimp trawls per month. Estimates for total bycatch (invertebrates included) ranged from 121,817 to 954,776 kg per month. The overall estimate of total bycatch during the March-November sampling period is approximately 4,268,380 kg.

Galveston Bay fishery independent survey data from March 1992 through October 1992 was obtained from the Texas Parks and Wildlife Department (TPWD). An analysis was performed to compare the survey data collected by a TPWD research vessel with the bycatch data collected by NMFS from active shrimp vessels. Catch per unit of effort (CPUE) values from the TPWD data set (grams per 10 minute tow from a 20 ft trawl) were linearly extrapolated to the level of the NMFS data set (grams per hour from a 32 ft trawl, March-July; or from a 44 ft trawl, August to October). Two statistical comparisons were performed on the standardized data. These included a Kolmogorov-Smirnov test for statistical comparison of length frequency distributions, and a Student t-test on the CPUE values for individual species. The Kolmogorov-Smirnov test was performed on 17 species (most numerically abundant or recreationally important) caught during the March-October period. Student t-tests were conducted to compare species-specific CPUE values during each month. Fifty-three total species were examined, although each was not present in the bay every month. No specific trends in statistical differences among the data sets were observed with either test.

Data of the 1992 samples include several noteworthy occurrences: On one occasion, several cormorants (*Phalacrocorax* spp.) were captured during successive tows, although it was impossible to determine whether they were dead prior to being captured. A large crevalle jack (*Caranx hippos*), a relatively fast-swimming species, was captured on one occasion. Some spotted seatrout and southern flounder (*Paralichthys lethostigma*) were found in oligohaline water (0‰) in Trinity Bay during April. Overall, however, relatively few recreational species were caught by trawls. Numerous freshwater species were recorded in Trinity Bay during April and May including blue catfish (*Ictalurus furcatus*), Ohio shrimp (*Macrobrachium ohione*), and alligator gar (*Lepisosteus spatula*).

Small Spanish mackerel (*Scomberomorus maculatus*) were captured occasionally in the middle and upper portion of Galveston Bay. A spotfin butterfly fish (*Chaetodon ocellatus*) and a lane snapper (*Lutjanus synagris*) were caught in Lower Galveston Bay.

Data collected during this study only reflect those species captured during trawling operations. No specific tests were performed to examine survival of discards. Almost all of the fishermen who participated in this study utilized culling boxes (plywood enclosures with flow-through seawater) on their vessels. Trawl-caught items are placed in these culling boxes to minimize mortality of live-bait and facilitate ease of sorting bycatch. A number of factors are important in regulating survival of bycatch species (tow duration, magnitude of total catch, water temperature, injuries sustained in capture and/or culling, predation, etc.). Future investigations on bycatch should attempt to address survival of discards as well as the ecological role of bycatch species in species population dynamics and nutrient cycling.

Bibliography

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